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solplan review

the independent journal of energy conservation, building science & construction practice

Inside . . .

Water conservation is gaining attention. Concerns about the infrastructure, supply and environmental degradation are pushing this. We report on a study that outlines the issues and jurisdictions that affect water policy.

We review what the CSA window standard actually covers - how windows are tested and what the markings really means.

CMHC's Healthy Housing Competition winners have been announced. We present the winning entries and review why they were outstanding.

The Advanced Houses program is progressing. We present an update on three of the houses under construction. Other items include findings and remedial action for drywall staining, proposed code changes for basement water proofing, moisture in lumber, and much more.

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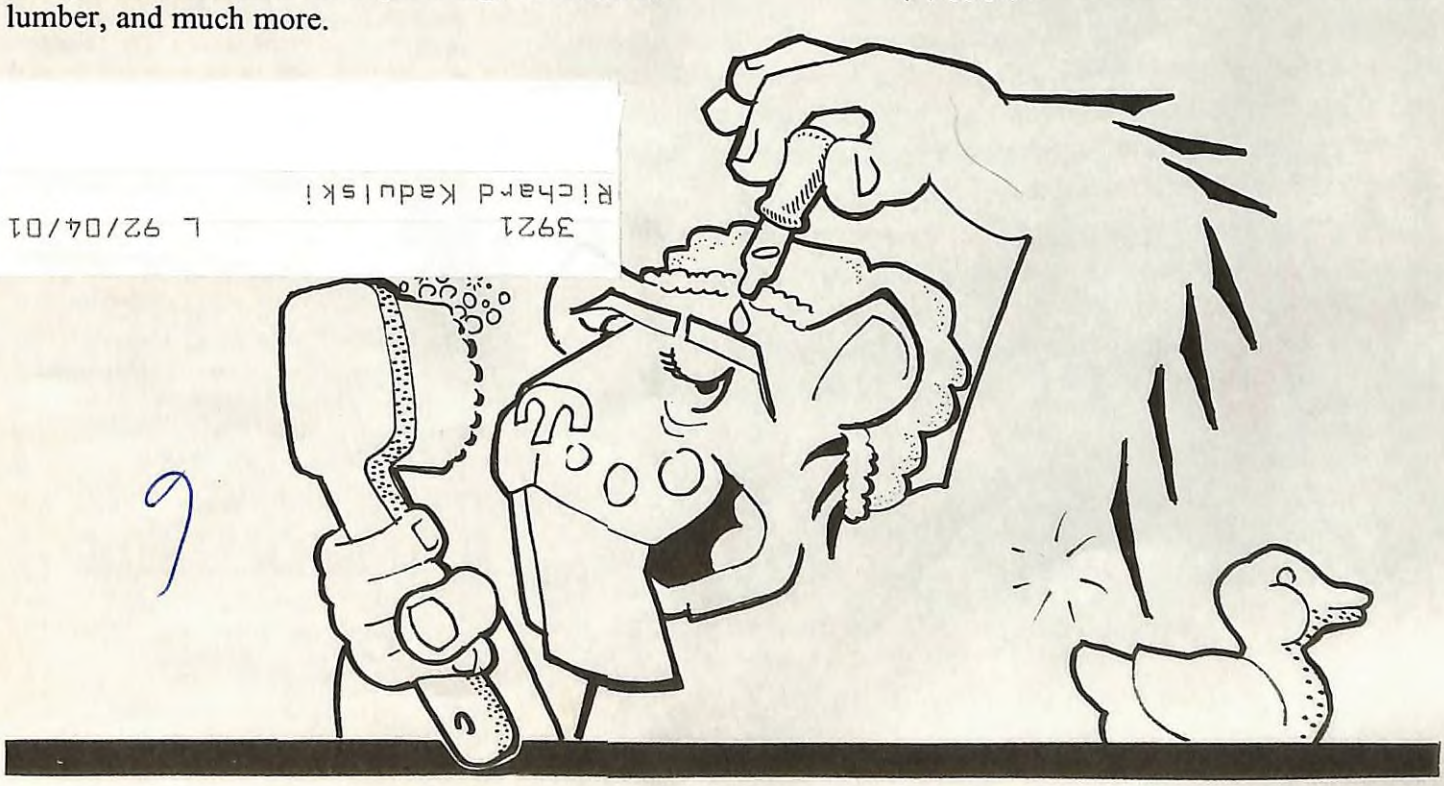
Water Conservation



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Richard Kadulski

From the Publisher . . .

The environment is gaining a higher profile every day. That we've made a mess of our environment seems to be sinking in. Some of you may still not be convinced, you may think that the environmentalists are doomsayers, overdoing the talk of doom and gloom.

But just think about how we've handled our environment. Our communities have sprawled. Every town has an ugly strip along its edges. Where is the pristine countryside? Take a walk in the woods - in the more populated areas of the country you'd be hard pressed not to find garbage and human artifacts everywhere. The fishing isn't as good as it used to be in the lakes and streams. If you're a hunter, you probably have a harder time finding the game you go after.

Take a flight across the country, and you'll see the scars or clear cut logging. Reforested or not, they will take some time to recover.

So what does this have to do with the construction industry?

It's a metter of attitude. Before you can do something about a problem, you have to recognize that you have a problem. I think that we are at that threshold now.

I was most pleasantly surprised by the mood of the CHBA annual convention in Winnipeg this year. I got the feeling that there was is the beginning of a greening of the housing industry. The announcement and display of the Advanced houses program finalists was a major feature; Denis Weaver was a keynote speaker, making a presentation on his unconventional earth sheltered houses, developed out of a conviction to use environmentally sensitive materials and construction approaches. What he's doing isn't going to be applied across the board, but it should get you thinking about it. The sessions on environmental and waste management concerns were extremely well attended.

One conference or meeting does not solve everything, but it does show that there is interest out there. There is still lots that has to be done to improve our track record. Let's not stop but make sure that everything we build can be justified from an environmental perspective. We owe it to our kids if not to ourselves.

We're not there yet, but the first steps have been made. Let's see more ''green homes'' as part of the normal building practice.

Richard Kadulski
Publisher

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Editor-Publisher: Richard Kadulski
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Richard Kadulski Architect
208 - 1280 Seymour St,
Vancouver, B.C. V6B 3N9
Tel. (604) 689-1841

Water Conservation

It may seem strange to talk about water conservation in Canada - the land of snow, ice and lakes. Although Canada is a water-rich nation, water conservation is becoming an increasingly important public policy issue especially in the urban areas.

We are beginning to recognize that while the sustainability of the resource is not threatened the ability of governments, provincial and municipal, to sustain the water and sewer infrastructure is being questioned. Barriers to the introduction of more water efficient technology into the residential sector are as much attitudes and bureaucracy as they are technological.

Demand for potable water has increased more then six-fold in the past ninety years - 75% of this increase occurring over the past 25 years. In some areas, water demand has exceeded supply. In addition costs of providing sewage treatment and water purification have risen significantly.

Canadians rank second only to U.S. consumers in per capita consumption of water, but there are significant opportunities to make major reductions in residential water consumption. Household water consumption can easily be reduced 10 to 15% with current, off-the-shelf technology. More advanced technology is also available to reduce average household consumption of water by up to 50%, with no detectable changes in lifestyle.

Historically, Canada has had some of the lowest water prices in the world, which has led to the resource being undervalued and overused. Previously municipalities relied on increases in supply to meet rising demand for water and sewer services. Now there is growing recognition that demand management can have a greater impact in improving the productivity of municipal water and sewer infrastructure.

While it may be difficult to argue for water conservation from a sustainability of the resource perspective in most Canadian municipalities, with notable exceptions, there is a growing recognition of the need for full cost accounting of all municipal services. In the face of rising costs, water demand management is becoming a priority for an increasing number of Canadian municipalities.

The municipality is the principal water retailer for about 75% of the Canadian population. It is at the municipal level where most opportunities for conversation and demand management are implemented.

The Municipal level of government is the closest to most water consumers. However, municipalities are limited in what they can do to implement water conservation programs. They are free to develop or deliver consumer education programs about water conservation but they can't make laws so they don't have the right to legislate water conservation measures beyond lawn watering bans.

Public education, by itself, will not yield large reductions in water use but it can be crucial to the success of urban water conservation programs. Municipal governments may not be able to legislate the use of water-conserving devices and fixtures, but can promote the use of such devices through give-aways and financial incentives.

Rural water and sewage disposal on the operating efficiency and lifespan of disposal systems, and impacts on ground water and aquifers is another concern.

To date no province has established a comprehensive water conservation program. Initiatives have been short-term in nature and fragmented in coverage.

To review the situation, CMHC commissioned a study. The objectives of the study were to document residential water conservation practices, products and approaches used successfully elsewhere; identify the advantages and implications for Canada of using similar products and approaches; investigate the codes and standards issues that affect the introduction and widespread use of water-efficient products and equipment identify the scope of possible residential water-efficiency design criteria; and provide a recommended marketing strategy to ensure that residential water conservation initiatives reach the proper target audience.

Public awareness and enthusiasm about environmental issues is boosting public interest in water conservation programs. This suggests the importance of putting an environmental ''spin'' on the water conservation issue to increase participation rates.

Typical house water use:

toilets	40%
showers & baths	35%
laundry & dishes	20%
cooking & drinking	5%

The most significant area in the home for reducing water consumption is the bathroom, where about 75% of the household water is used. Just replacing a conventional toilet (29 litre per flush) with a 6 litre ultra-low-volume flush toilet will reduce water consumption associated with toilet flushing by 70%, and total household water consumption by nearly 30%. (if you reduce water consumption per toilet flush by 9 litre/day, a toilet flushed 6 times/day means an annual saving of 20,000 litres)

Using only low-cost approaches, (and less than state-of-the- art fixtures) water use in a house could be cut by 30 to 50% with no lifestyle changes. In a retrofit situation, these approaches can reduce water use 19 to 44%.

A 1991 Ontario study estimated that installing low-flow aerators in the kitchens and bathrooms in a 719 unit highrise apartment complex would reduce water use by 33%. Such a reduction in water use gives annual saving in water, waste water, and natural gas charges equal to the costs of the purchase and installation of the low-flow aerators, resulting in a payback of one year.

Some minor changes will have to made to the Canadian Plumbing Code to reflect low consumption fixture hydraulic loads and venting requirements to allow designers to get the full economic benefit associated with low consumption fixtures.

Water conservation initiatives can be thought of as short-term or long-term. Short term are emergency responses situations, like the garden sprinkler bans during a dry summer. Long term measures provide water savings for as long as they are in place.

Long-term water conservation initiatives can include a range of items. U.S. experience suggests that making water rates reflect the real cost of water leads to significant reductions in residential use; metering water use goes hand in hand with usage and price increases.

Leak detection and repair can also be very cost-effective, with a minimum disruption to the service.

Metering can be costly but it seems that it is generally a cost-effective measure, with a payback through the millions of dollars in infrastructure costs that can be avoided.

The majority of residential water use outdoors is dedicated to horticultural purposes. During the growing season, residential water use can rise by 50% or more. Much of outdoor water is wasted due to evaporation or run-off through over-watering and other inefficient watering practices.

A typical suburban lawn (approx. 350 sq metres) can require up to 200,000 litres of water during a single growing season. A low-maintenance landscape, by comparison, could conceivably require no water inputs except that provided by nature through precipitation.

In addition to quantity issues, landscape practices have an effect on water quality as well. The residential sector uses up to 10 times more toxic chemicals (fertilizers, herbicides, and insecticides) per acre than the agricultural sector. Chemical run-off can seriously impact ground-water reservoirs and add to the cost of water treatment downstream.

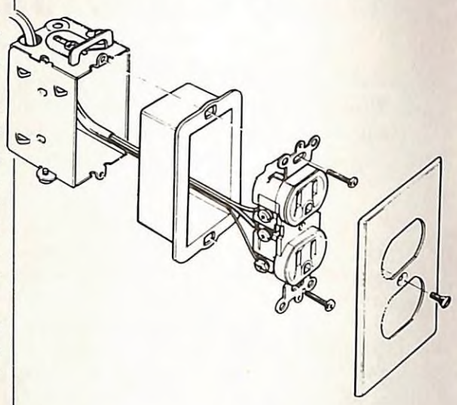
The Advanced Houses being built across the country will be demonstrating a range of water conservation features and water conserving landscaping designs.

"Residential Water Conservation: A Review of Products, Processes and Practices" prepared by REIC Ltd. with Brown and Caldwell Consultants, Habitechnica, and L. Covelli Consulting for Canada Mortgage & Housing Corp.

What builders can do to promote waterconservation ?

use:
- low flush toilets
- low flow shower-heads
- tap aerators that reduce water flow
- install or recommend the use of water efficient appliances (dish-washer, washing machine)

Airtight Electrical Boxes: A Retrofit Insert option



R&S Enviro Products has developed a retrofit insert specifically designed to fit inside existing electrical boxes, thus reducing heat loss and air leakage. The inserts are made of Santoprene rubber which is thin enough to be pierced by the wiring without any tools. Available in single and double configurations; triple and octagon styles are to be ready shortly.

R&S Enviro Products, 1 Church Street, Unit 10, Keswick, Ontario, L4P 3E9

Directory of Barrier-Free Building Products: revised and expanded

This directory provides sourcing information on household products necessary for building for the disabled. This Canadian Directory is one in a series of publications and design tools offered by the Barrier-Free Design Centre. The centre is a non-profit group dedicated to making buildings accessible to all. They can provide expertise on a wide range of consultation, education and information services to industry and to the public.

Barrier-Free Design Centre
2075 Bayview Ave., Toronto, ON
M4N 3M5
Tel: (416) 480-6000
Fax: (416) 480-6009

CSA-A440: the Window Standard

Standards are always referred to in codes and other regulations. But who reads them? Who has actually looked at one? Manufacturers do. Inspectors might occasionally. But as builder or product specifier, do you really know what's in a given standard?

How often have you seen a product ad say it meets a given CSA or ULC standard? It may often cover something different than you think!

With recent changes in window technology, the CSA standard for windows has been modified. We thought it would be interesting to look at what it actually says.

Exciting entertainment it ain't! It makes good bedtime reading - if you have a hard time getting to sleep. But it does spell out in great detail what and how window tests are done.

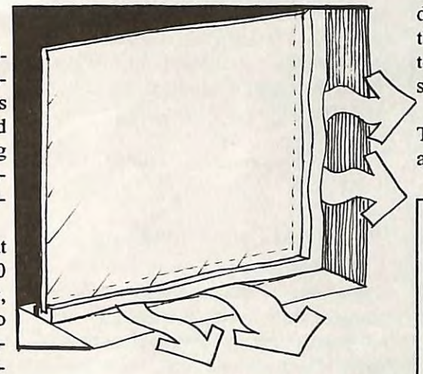
There are several sections to the standard, all under the main heading of CSA-A440. The document provides definitions and spells out how tests are to be carried out. It applies to both fixed and opening windows that are factory-assembled, intended for vertical installation in buildings

Manufacturers wishing to prove that their windows comply with CSA A440 submit a 1000 m wide, 1000 m high unit, complete with all hardware and screens to an accredited testing laboratory. The sample for testing is chosen by the manufacturer and must be a typical unit off the production line.

The window is installed in the test chamber following the manufacturer's instructions for installation with all operable lights in the closed and latched position.

Window Classification

Windows are classified for their Airtightness, Water Tightness and Wind Load Resistance.



Air Tightness

Air leakage is caused by wind, internal positive or negative pressure, and by stack effect. Excessive air leakage will lead to discomfort and drafts, low relative humidity due to too high an air change rate, noise transmission due to sound leakage, as well as dust and airborne pollutants that are carried in the air. Air leakage during both summer and winter may be a significant contributor to energy loss.

Tighter windows reduce the air changes and increase the relative humidity. Leaky windows also increase the potential for condensation on both window frames and glazing as the surface temperature is lowered.

The air tightness test rates a window based on the amount of air that can pass through a closed window from the outside to the inside at a given wind pressure. Air infiltration through a window is measured under ambient temperature conditions (20°C) at a pressure difference of 75 Pa. (this represents a wind speed of 25 mph.).

With operable windows, most of the air leakage occurs through the joists between the sash and the frame and between meeting rails of the sliding sash. The ratio of the length of this crack to the window area decreases with increasing window size so the leakage per unit area of window will tend to decrease with increasing window size.

Air tightness ratings are A1, A2, A3. The tests measure the maximum air leakage rate.

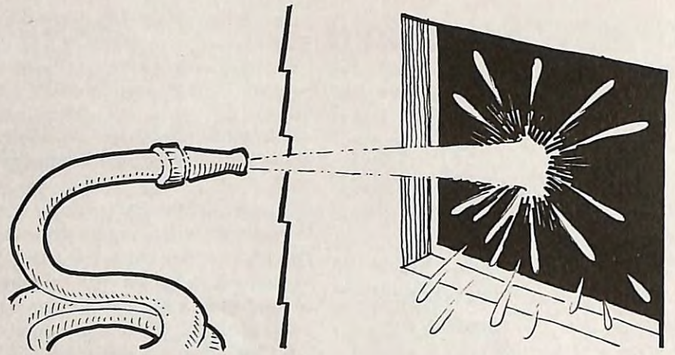
Maximum air leakage rate per lenght of crack

	$m^3/h/m$	cu.ft./hr/ft
A1	2.79	30.03
A2	1.65	17.76
A3	0.55	5.92

Water Tightness

For the water tightness test, the window is mounted in a chamber and an even film of water is sprayed onto the outside while the window is subjected to the appropriate positive pressure. During the test the pressure is cycled four times, each cycle of five minutes with the pressure applied and one minute with no pressure.

Water is not allowed to penetrate the window to cause wetting of the interior surfaces or through the window into the wall below the sill; and no water shall remain trapped in the window assembly



after the test pressure has been released.

Water tightness ratings are B1, B2, B3.

Test pressure difference (Pascals)	
B1	150
B2	200
B3	250

Wind Load Resistance

Wind loads are the main structural forces windows must resist. The objective of the wind load test is to determine how rigid the sash members are and to check the strength of a window assembly subjected to the extreme pressure differentials caused by the wind. The amount of deflection is used as an indication of this strength. Sash members can't deflect more than 1/125 of their length; and mullions shall not deflect more than 1/175 of their length.

The window is subjected to a load equal to half the test pressure for a minimum of 10 seconds. The full pressure is then applied both in an inward and outward direction.

For both loading directions, deflections are measured at the midpoints of all meeting stiles, mullions, muntins or at the most restrictive location after the pressure has been applied for 10 seconds and while it is still being applied.

Windows are also subject to operating forces which affect the hardware design, its attachment, and the members to which it is attached.

No failure or permanent deformation of any part of the window that may cause any operational malfunction is allowed. If the glass breaks, two re-tests must be done. Glass breakage during either of the two re-tests is a failure of this test.

Wind load resistance ratings are C1, C2, C3.

Material Specifications

In addition to performance, minimum material specifications for all component materials are given. These requirements are based on acceptable design principles, historic applications and good manufacturing practice as well as minimum requirements for: hardware and fasteners; weatherstripping; insect screens; and foam or sponge materials.

Materials specifications include items such as wood preservatives: the preservative must be certified by the preservative manufacturer, using independent laboratory tests, and must be registered under the Pest Control Act, have a registration number from Agriculture Canada, and can't have any detrimental effect on paint finishes.

For wood frames maximum moisture content is spelled out, minimum wall thickness for vinyl or metal frames. Specs also cover finishes: anodized coatings for aluminum, enamels for wood, and vinyl weathering characteristics.

A new item included in the latest revisions requires that except for storm windows, *all metal windows must incorporate a thermal break.* This is a new requirement that, if enforced, is going to have some impact on the West coast as non-thermally broken aluminum frames have a large market segment.

The material specifications also identify glazing, sealing compounds, and adhesives. Weatherstripping must be made of a material that is resistant to deterioration by weathering or aging and be compatible with the window frames. Open cell plastic foam can't be used nor can surface-applied, glued-on weatherstripping.

Minimum glass thickness is governed by the requirements of the NBCC or other appropriate regulatory authorities.

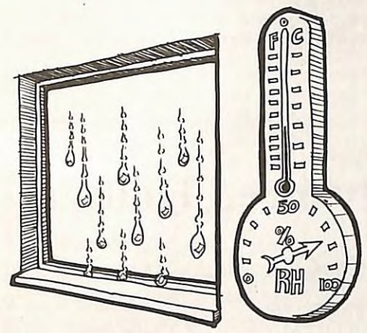
When the window is installed properly, following the manufacturer's instructions, exposed horizontal surfaces wider than 6mm must be sloped to shed water. Insulating glass units must be glazed in a manner that prevents accumulation of water in the glazing cavity. The drainage system must prevent contact between any accumulated water and the seal of the insulating glass unit.

Window design must allow on-site reglazing

Windows complying with all requirements of this standard should have the following information attached: the manufacturer's identity permanently marked on each window so that the mark is visible when the window is installed. A second label (it need not be permanent) must indicate what classifications the window meets for air tightness, water tightness, and wind load resistance (e.g. something like A1, B2, C1).

Condensation Test

A condensation resistance test is also done. This determines the Temperature Index (I) for glazing, sash, and frame. The Temperature Index, when used in conjunction with the winter (January) design



temperature for a given location, identifies the maximum relative humidity that the glazing and sash or frame can take before surface condensation happens. Knowing (I) allows a specifier to determine if a window will be suitable for the conditions to which it will be exposed, and thus avoid excessive condensation.

To determine the Temperature Index the window is subjected to temperature conditions of -30°C outdoors and 20°C indoors, and the inside surface temperatures of the glazing and sash of the frame are measured. If the temperature of the inside surface of the window glazing or frame drops below the dew point (a function of the interior relative humidity), condensation will appear on these surfaces.

Energy rating (ER value)

A new addition to the standard is the energy performance rating.

The energy rating provides a method for comparing different window products based on their effect on annual energy supplied by the house heating system.

The ER equation incorporates three elements: solar heat gain, heat transmission loss and heat loss associated with window air leakage.

In developing the energy rating, each of the weather factors in 13 major Canadian cities were averaged, including solar radiation incident on windows facing the four cardinal compass directions, to produce a single set of average weather conditions. Rating values based on these average conditions do not apply to any specific location. Ranking of the windows offers a comparison - along the lines of the gas consumption figures for trucks and cars.

An ER value can also be calculated for a specific location and orientation. This is known as the ERS. The method for obtaining ERS values for a specific location and orientation is also provided in the standard. The ERS values can be used to make a comparative estimate of the effect on annual heating energy requirements of alternate window installations.

A User Guide in the standard provides a method for making such estimates.

For further information: Canadian Standards Association, 178 Rexdale Blvd. Rexdale, Ont. M9W 1R3

B.C. R-2000 Agreement

The R-2000 Program gained a new lease on life in B.C. when program partners (BC Gas, Bank of Montreal, the Canadian Home Builders' Association of B.C., Energy, Mines and Resources Canada, the New Home Warranty Program of B.C. and Yukon, and West Kootenay Power) signed an agreement formalizing their commitment to the delivery of *R-2000 - The Energy Efficient New Home Program in B.C.*

Effective April 2, 1992 the R-2000 name will replace Quality Plus in all promotion and communication to industry and the general public, allowing builders and the provincial Program to take advantage of R-2000 national advertising and name recognition with consumers. Builders who were qualified to construct certified Quality Plus Homes automatically qualify to build R-2000 homes.

Purchasers of R-2000 homes qualify for mortgage rate discounts through the Bank of Montreal, and may qualify for additional cash rebates, grants and low cost loans depending on the utility by which they're serviced.

Why the change?

When the Quality Plus program was introduced the R-2000 label was dropped because it was perceived that R-2000 wasn't recognized by the public - it had a low profile and was too "techie". After a couple of years it seems the public doesn't recognize or understand "Quality Plus" while R-2000 (surprise, surprise!) has a high recognition.

Conspicuous by its absence from the list of sponsors is B.C. Hydro (a prime mover of the Quality Plus program). At the moment they are reassessing their position and how they will participate.

HRV Industry Merger

Conservation Energy Systems, Inc., North America's longest established manufacturer of residential heat recovery ventilation systems has been acquired (as of April 1, 1992) by **Venmar Ventilation Inc.** of Drummondville, Quebec. Rick Olmstead, President of CES Inc. will maintain a major position in CES.

The vanEE™ Heat Recovery Ventilators (HRV) have been marketed in North America since 1980.

Venmar Ventilation Inc is a major Canadian manufacturer and distributor of home ventilation equipment. The company has developed a full line of products utilizing leading edge manufacturing technology.

The distinct product lines that have made each firm successful will be maintained after the merger.

EMR/CANMET NEWS

The Canada Centre for Mineral and Energy Technology (CANMET) is the research and development arm of Energy, Mines and Resources. EMR/CANMET's Buildings Group works with industry to develop and commercialize the technologies to make Canadian houses more energy efficient. With the support of the Buildings Group, Solplan Review presents this information on some current CANMET projects. For more information contact: Energy Efficiency Division, EMR/CANMET, 580 Booth St., Ottawa, K1A 0E4.

Canadian Energy Management and Environmental Training Program (CEMET)

With Canadian industry facing increasing competition, rising energy costs and rising concern over the environment, the need for training in energy management and related environment impacts, especially for the industrial and commercial sectors, is important.

Responding to that need, the Energy Efficiency Division of CANMET, in partnership with the Canadian Gas Association and community colleges, launched CEMET (Canada wide Energy Management and Environmental Training Program). The announcement was made on April 15, by Pauline Browes, the Minister of State for the Environment.

The program promotes energy efficiency and environmental awareness. It will be of interest to energy users such as plant operators, energy managers, technicians, suppliers of services and equipment, apprentices and others who can benefit from training in energy management. It is designed around ten training packages, each related to specific energy-using gas and electrical mechanical systems and facilities. 20 technical manuals covering everything from architectural considerations to automatic controls and planning and management have already been developed.

Because this is a partnership, an Executive Director has been appointed to ensure that the links established between industry, governments and the community colleges are maintained.

Two pilot courses are being delivered in six colleges across Canada in May: *Boiler Plant Systems* and *Steam and Condensate Systems.*

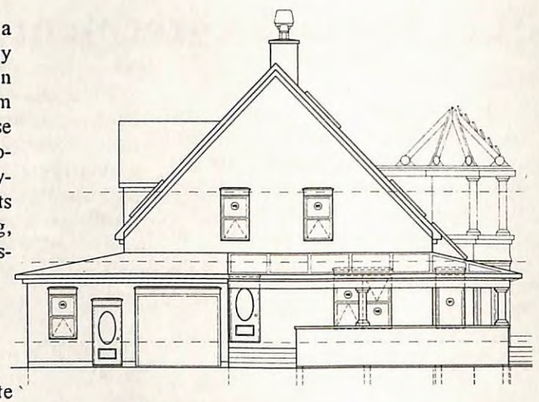
For further information contact:
Listor Robinson, Executive Director
Canadian Energy Management and Environmental Training Program
CEMET Box 385, Oshawa, Ontario,
L1H 7L7 Tel: (416) 576-0210
Fax: (416) 436-9774

Update on the Advanced Houses Program

The Advanced Houses are advancing. Ten of the winners are already set to break new ground. Each of the Advanced Houses had to meet the same set of technical requirements including: environmental targets, such as a water usage target and a construction waste management plan; and energy performance targets (for total energy use) which are set at one-half that of an R-2000 house of similar size and occupancy.[1] These stringent targets demanded innovative thinking at almost every turn.

In the next few issues of ***Solplan Review*** *we'll be reporting on the progress of each of those projects - beginning in this issue with a look at three houses that are already under construction.*

The Prince Edward Island Advanced House



The P.E.I. House is a one and on-half storey wood-frame structure ten kilometres from Charlottetown. The house features a number of innovations, from its energy-efficient foundation to its self-sufficient heating, cooling and electrical systems.

The Seaweed Sandwich

The construction site was covered with a "seaweed sandwich" - a combination of seaweed and baseclad insulation. The sandwich was used to prevent the excavation site from freezing so that construction could begin before the winter was over. The sandwich found a second life as insulation in the preserved wood foundation.

[1]Total energy performance is defined as the sum of the space-heating, space-cooling, water-heating, lights, appliances, and outdoor electricity consumption. Energy consumption in one area could be traded off against other consumption targets as long as the calculated total energy consumption of the house is less than the sum of the individual targets.

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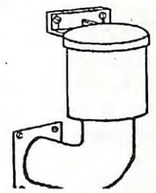

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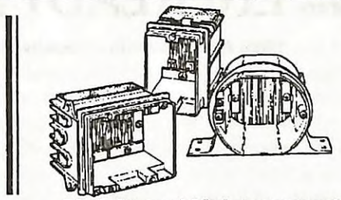

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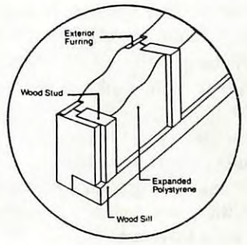

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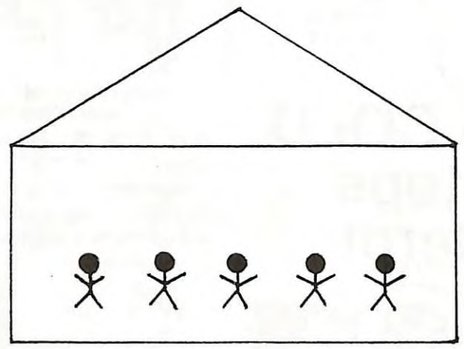

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Home Automation

The 1990's will herald the introduction of innovative and exciting home automation developments that will profoundly affect the way we live, work and play.

Two of the Advanced Houses (Hamilton and Vancouver) will be taking advantage of full home automation systems.

Just think of the possibilities. You're interested in convenience as well as energy savings. A "good-bye" button at the back door makes the house to check itself when you leave home. It checks to see that the security system is armed, the phone answering machine is on, lights are out, windows shut, and the heating system set back. It can also check to see that appliances have been turned off (for those that forget to turn off the coffee pot). Anything that was left on and shouldn't be is turned off.

Or your daughter is concerned about coming home to a dark house. Her remote unit can call the house and if no one is home, the lights can be turned on before she gets there. More comfort and security.

Your elderly mother lives in an apartment. She gets up during the night regularly; as she moves, some lights turn on and off gently as she passes by.

These are just a few examples of home automation systems.

The Canadian Automated Buildings Association has just published *Home Automation Systems: An Overview for Canada.* This 90 page overview report is written in an easy to understand style. It introduces home automation, describes systems available and explains some of the key projects which are supporting the development of these systems. Included are *CEBus, Echelon, SMART HOUSE, X-10* and others. How home automation systems will provide value-added benefits for Canadian consumers are noted.

The Appendices provide directories of Manufacturers, Installers, Distributors, System Integrators, Consultants, Research Firms, Utilities, and Industry Associations, and Press Coverage.

Anyone who wishes to get a picture of what's going on should look at this document. If you are seriously looking at automation, the price is well worth it before making major investments.

Home Automation Systems: An Overview for Canada - $50.00 (plus GST). Available from:

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HOT 2000

WHAT IS IT?

HOT2000 is an advanced approach to the design and modelling of energy efficient structures.

HOT2000 is an easy-to-use computer program designed to assist builders, architects and engineers design low-rise residential buildings. Utilizing current heat loss/gain and system performance models, the program aids in the simulation and design of buildings for thermal effectiveness, passive solar heating and cooling systems (cooling calculations version 6.0 only).

WHAT CAN IT DO FOR ME?

HOT2000 lets you input comprehensive data on proposed building design, analyze the expected heat loss/gain, and revise and test altered designs until a satisfactory design is achieved.

Contains extensive weather data, several models for HRV, foundation, water heating systems and more.

HOW TO GET HOT 2000

HOT2000 is available from the Canadian Home Builder's Association (CHBA) in either a Canadian or USA version at the following prices:
* $120.00 (Cdn) for v. 5.06 Canadian version
* $150.00 (US) for v. 5.06 for the USA version (US weather data)
* $225.00 (Cdn) for v. 6.0 Canadian version
* $275.00 (US) for v. 6.0 US version (US weather data)

Price includes User and reference manuals

To order HOT 2000, complete the attached form and send it with a cheque or money order to:

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Preserved Wood Foundation

The PWF for the house was prefabricated as modules and shipped to the job site the same day the excavation was completed. The modular system, in conjunction with the construction sequencing, meant that the foundation could be installed and backfilled before frost could penetrate the backfill material and the area beneath the basement floor. Prefabrication also reduced onsite construction waste.

Heating, Cooling and Domestic Hot Water

Heating, cooling and some DHW needs will be met by a prototype ground source heat pump (GSHP): the Chinook Hot Spring, originally developed with funding from CANMET. Typically GSHP's are linked to a forced air heating system. In this case the GSHP is linked to a hydronic (radiant floor) heating system. In addition, the pipe in the ground that contains the circulating fluid (to extract heat from the ground) is a revolutionary 'spiral loop' developed by the National Research Council. The spiral allows greater pipe lengths to be installed in shorter trenches, substantially reducing installation costs. For example, 500 feet of pipe requires only 75 feet of trench. A coefficient of performance of 3.5 is anticipated.

Electrical Needs

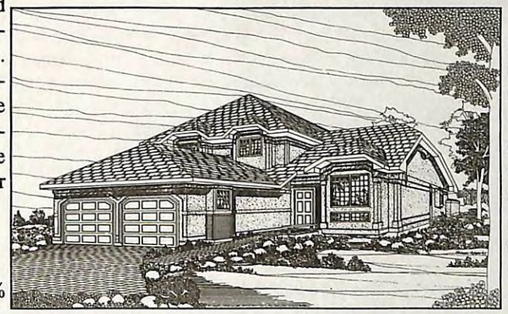
Most of the electrical needs will be supplied by a small wind mill when the wind blows greater than 15 km per hour. Excess electricity will be fed back into the electric utility power lines. A photovoltaic collector will supply any shortfall in electrical requirements.

Windows

The high performance windows are manufactured by Visionwall™ of Edmonton. They have an average R value of 6.3. The windows consist of four layers: two plastic films suspended between two layers of glass. The total assembled unit thickness is 4 inches.

The Manitoba Advanced House

The Manitoba Advanced House is a two-storey, four-bedroom home in Winnipeg. In addition to numerous energy-efficient innovations, the house features a number of innovations designed to improve both the indoor and outdoor environments.



Air Filtration System

The House will use an 85% efficient "bag filter". The filter is essentially a series of specially designed pockets that stretch, not just across the duct, but three feet in length down the duct. The increased surface area allows the use of finer fabric in the filter to trap smaller particles - without restricting air flow. The bag filter as well as a gas absorbing filter are placed in a special duct section on the return air duct of the furnace. Fresh outdoor air and return air flow from the house passes through the filter before reaching the heating element.

The "Hobby" Room

A hobby room has been designed to be used for activities which may contaminate indoor air (e.g. painting or smoking). In terms of air flow the room is isolated from the rest of the house. The room is supplied with separate heating (electric resistance) and ventilation systems. Most importantly, an HRV will run continuously at low speed to keep the room under a slight negative pressure to ensue that contaminated air flows out of the house and not into other living areas.

Water Related Innovations

The house features a number of water related innovations. A rain water collection system to supply water for all outdoor uses; low water usage landscaping; and a DHW pre-heat system which recaptures waste heat from greywater.

Natural Gas Systems

With Manitoba moving away from electrical use, the design team decided to feature a number of products that are powered by natural gas. A high-efficiency (93%) integrated gas space heating and domestic hot water heating system, a gas dryer, and all exterior 'ornamental' lights are gas powered.

Energy-Efficient Mortgage

The House offers potential purchasers a reduced interest rate on the mortgage. Under a deal struck with the Canadian Imperial Bank of Commerce, the bank will offer a quarter point off the going mortgage rate. For the bank, the lower operating costs of the house means that homeowners are less likely to get into financial difficulties. For the homeowner, the lower mortgage rate helps makes up for the incremental cost incurred in the construction of an energy-efficient home.

Electromagnetic Field (EMF) Control

To avoid potential human health impacts associated with EMF, the stucco wire has been grounded, channelling any EMF away from the house.

The Saskatchewan Advanced House

The Saskatchewan House is a two-storey, 2,460 square foot double-wall structure in Saskatoon. 'Innovation' was a key word for the Saskatchewan team. As a result, the house features a number of systems that should set the building community thinking about new directions for housing.

Photovoltaic System

The photovoltaic (solar electric) system has been sized to run all of the mechanical systems including the HRV, the circulating pumps that drive the floor radiant heating system and the ceiling radiant cooling system. Photovoltaics also power outdoor lighting and indoor 'emergency' lighting (hallways and stairwells), making the house virtually autonomous in case of utility power failure.

The Cooling System

The technical requirements do not allow the use of appliances, such as air conditioners, that use CFC's. Two cooling systems were developed for this house: one was a ground source system, buried under the slab, and connected to the ventilation system, the second was a ceiling radiant cooling system of water filled pipes runs through the ceiling to remove heat from the upper floors. The ceiling system requires only a small circulating pump which is driven by the electrical output of one photovoltaic cell.

Hot Water

The house uses a solar hot water heating system using vacuum tube collectors and a thousand gallon storage tank in the basement. The storage tank provides DHW and heat for the floor radiant heat system as needed.

Greywater Heat Recovery System

A prototype greywater heat recovery system will recapture heat from waste water to reduce peak loads on the solar DHW system.

Gas range and gas washer-dryer

Other prototypes include a sealed combustion gas range that vents exhaust gases directly outdoors. The washer and dryer share the same chamber. The unit is front loading, which reduces water use, and spins at a high RPM speeding up the drying process.

Electrical-Use Monitor

A monitor tracks electrical use continuously. Read-outs can be provided on a daily, weekly and monthly basis to allow residents to analyze consumption patterns. Usage figures can also be converted to a dollar amount as an added incentive to conserve.

Energy Efficiency and Renewables: Recent European Experience

In Canada energy efficient building practices are well advanced, because of the efforts of the R-2000 program. But what about other countries? Sometimes it's good to see what's happening elsewhere.

In Europe awareness of environmental problems is high. There is a recognition that burning fossil fuels and the resulting carbon dioxide (CO_2), threatens to cause disastrous climatic change. A German parliamentary enquiry concluded that northern Europe will have to reduce CO_2 emissions by about 85% in the next 60 years. In the UK buildings use more than 50% of total energy, a much higher portion of energy use than in North America, where transportation (i.e. the private automobile) is the largest single energy user.

In the move to more energy-conscious, ecologically sound buildings Switzerland, Germany and the Netherlands are the leading countries in Europe, but work is dispersed among regional government, manufacturers, research institutes, practitioners and individuals. The language barrier has also slowed the spread of information.

We were interested to receive a copy of *Energy Efficiency and Renewables: Recent Experience on Mainland Europe.* The report was written by David Olivier, of Energy Advisory Associates for a UK audience. This very readable report offers a view of what's happening in Europe. It describes standard building practice and the recent changes in the energy performance of dwellings and commercial buildings, pointing out what has generally worked well, and what has not.

The report shows how energy efficiency has been incorporated into the fabric and services of domestic and small commercial buildings, and how renewable energy technologies (e.g. passive and active solar, photovoltaics), have been incorporated into building design. It describes 30 energy-efficient and solar building projects, most built 1988-91.

New homes in Schiedam, in the Netherlands, use a fifth as much gas for heating as their counterparts did in 1975. In Germany and Switzerland, conventional double glazing is obsolete; far more energy-efficient systems are taking over. About 40 homes in Switzerland and Germany use negligible fossil fuel for space heating. Some Swiss glazing systems admit as much energy from the sun as double glazing, but insulate better than brick walls. An estate of 450 flats in the Netherlands have been 'superinsulated'.

It's interesting to note that problems are often similar to ones we see here; often it's a matter of cockiness on the part of the builder. The author relates how one German builder imported some prefab buildings from Sweden, and was so sure of their performnace thaat he offered enregy savings guarantees for the houses. Unfortunately, they didn't do their homework, they dind't pay attention to the small details so the houses we not as air tight as they needed to be to ensure proper performance. Energy consumption was 2.5 times what they should have been.

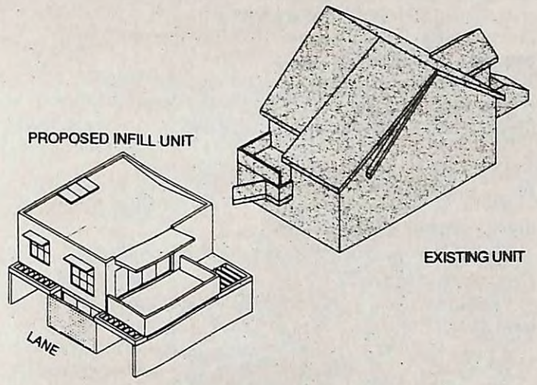
Energy Efficiency and Renewables: Recent Experience on Mainland Europe
Copies are £ 75.00 available from:
Energy Advisory Associates
8 MeadowDrive, Credenhill,
Herefordshire,England HR4 7EF
Fax: (0432) 760787-0088

CMHC Healthy Housing Competition

The design of Healthy Housing involves healthy indoor environments, energy efficiency, resource efficiency, environmental responsibility and affordability. Canada Mortgage and Housing Corporation sponsored the Healthy Housing competition. It challenged teams to develop new designs to meet these criteria.

Winners of CMHC's Healthy Housing Design Competition were announced in Vancouver at the Globe '92 Conference. They are Martin Liefhebber Architect of Toronto and the team of Habitat Design & Consulting and Greg Johnson Architecture/Engineering of Vancouver.

The winning designs include innovative and affordable ideas. Both offer new solutions to urban infill problems. Each combines high levels of efficiency for energy and resources with low environmental impacts and measures to improve occupant health.



Habitat Design & Consulting (Chris Mattock) and Greg Johnson Architecture/Engineering

This design is notable for its attention to occupant health and indoor air quality that has been achieved by careful selection of building materials, avoidance of moisture problems and balanced ventilation.

The infill is designed to use the latest in technical knowledge to minimize the embodied energy in materials, minimize lifetime energy consumption, and provide the healthiest possible environment for the occupants.

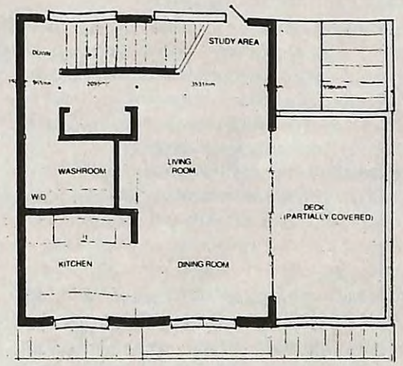
The dwelling is not large, only 918 sq. ft., designed for occupancy by two people. The internal layout of the unit was kept simple and open to reduce construction costs and ensure the relatively small spaces feel as large as possible.

The proposed shared site (33' x 122') is typical of many Vancouver residential areas. It could be widely applicable if zoning by-laws concerning density are adjusted.

The design uses wood frame construction on a slab-on-grade foundation. Advanced framing techniques reduce the amount of framing lumber which improves the thermal performance of assemblies. The Airtight Drywall Approach was chosen to create the air-vapour barrier.

To deal with concerns about extra loads on the community infrastructure (especially water and sewage), the design shows that if modest upgrades are done to the existing principal house total municipal loading is reduced, even with two dwellings tied into the grid in place of one.

One area in which this design excelled was the attention paid to occupant health, in particular, indoor air quality. The criteria for selecting materials to avoid off-gassing was



Habitat Design & Consulting winning entry

extensive and exacting. A balanced mechanical ventilation system, which meets CSA F326, minimizes the entry of soil gases and outdoor air pollutants.

What is the predicted performance?
Energy for space heating: 18,322 kWh/yr (approx. $550/yr assuming $0.03/kWh gas equivalent).
Energy for light and appliances: 5,840 kWh/yr ($409/yr assuming $0.07/kWh).
Total annual operating costs for all energy: $1,276.00.
Annual water consumption: 77,000 litres/capita
Construction cost is estimated at $112,660.

Selected comments from jury members:

Attractive without detracting from the principal residence - solves problems nicely.

The whole project is quite sensitive and a really good response to urban infill.

Technically competent and workable, using available technology. The real innovation is in the housing design.

A good idea. Makes intensification attractive, especially for elderly and physically challenged.

Martin Liefhebber Architect

An outstanding environmental feature of the Liefhebber design is its independence. This autonomous solution offers an answer to concerns about community infrastructure. The design shows that it is not necessary to be connected to the electricity or natural gas utilities or to the water supply or sewage infrastructure.

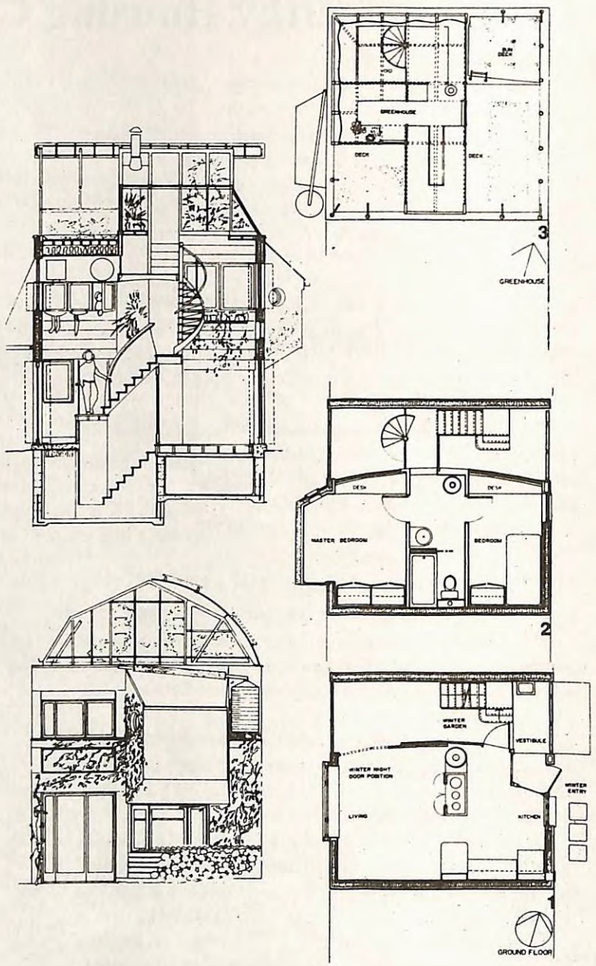
It is based on principles of Environmental Responsibility. It will return more to the natural and social infrastructure than is taken out; contribute to the fundamental needs of its inhabitants with a minimum of demands for energy consuming resources.

The house will not use the sewage and waste disposal infrastructure. Rather, it will contribute to the regeneration of the biotic mass and provide for the fundamental needs of its inhabitants with a minimum waste of natural resources.

The house is not meant to be connected to the energy grid, but combines passive solar gains (through the solarium) with a wood heater for space heating and photovoltaics for electrical generation. The house is also free of the city water supply and treatment infrastructure. It has a rainwater recovery system; two water purification systems; grey water recycling an organic waste composting tank; and ultra low-flow fixtures (including a toilet that requires only 1 cup of water per flush).

The house is a three-storey dwelling on an area not much larger than would be occupied by a two-car garage. The proposed site is in the centre of Toronto on a typical 26' x 138' lot, but the principles could be applied to any location.

The wood frame construction is located on a foundation of Durisol Wall forms with reinforced concrete. (Durisol is a moulded and compressed material composed of only raw natural materials such as wood shavings.)



Martin Liefhebber Architect, winning entry

What is the Predicted Performance?
Energy for space heating: annual heating load (in Toronto) of 2,750 kWh supplied by 3/4 of a cord of wood.
Total annual operating costs for all energy: $832.00.
Water consumption: system supplies 13,602 - 22,700 litres per year.
Construction cost is estimated at: $118,155.00.

Jury comments included:

Revolutionary in getting off utility grids (gas, electricity and water) yet coming in at a reasonable cost.

To build this entry would be to push the development of housing design and technology.

Attempts to integrate a lot of new ideas. Has very exciting features.

Honorable Mentions

The Jury awarded four Honourable Mentions:

A.R.E. Alternative and Retrofit Energies Inc. Calgary, Alberta

Team: Jorg Ostrowski, Helen Ostrowski, Orion Low and Tony Argento

For the design of the retrofit of a large two-storey suburban home to provide 3 units, one for persons with disabilities. Features include extensive use of solar energy and 67% reduction in water use.

Studio 125 Inc. Architect, Etobicoke, Ontario

Team: Blake Millar, Jiri Skopek, Michael Ankenmann, Dr. Joseph Krop and Richard Tamkin.

A 2-storey, 4-bedroom single family home which is also suitable as row housing or for apartments. Front and rear porches provide summer cooling and winter solar heating while a central staircase and belvedere window provide natural lighting. Features considered include indoor air quality and efficiency in energy and water use.

Urban Environment Centre Toronto, Ontario

Team: Robert Tmej, Geg Allen, Roger Algie, Ed Lowans, Henny Markus, Michael Holm, and Rob McMonagle

Retrofit of a large, semi-detached 80 year old home to include a suite for a hypersensitive individual. Features an Emphasis on indoor air quality and solar contribution.

Healthy Homes Consulting, Lower Sackville, Nova Scotia.

Team: Robin Barrett, Tom Livingston, Tom Emodi and Peter Meridew

Design for an affordable 2-storey 3-bedroom suburban frame construction detached home intended for a "cluster" development. Features High levels of energy efficiency and staged construction to provide affordability.

The Jury

The jury was a group from across the country with expertise in a range of fields, from health to building science:

Dr. Stephen Barron: Family Physician, Vancouver.

Professor Robert Besant: Head of Mechanical Engineering at the University of Saskatchewan.

Dr. Avi Friedman: (Jury Chairman): Professor of Architecture and Director of the Affordable Homes Program at McGill University, Montreal.

Richard Kadulski: Architect and publisher of **Solplan Review,** a journal on low energy building and building science, Vancouver.

Kathleen Kurtin: Architect specializing in renovations and conversions, Toronto.

Richard Lind: Builder/renovator, Vice-Chairman, Technical Research Committee of Canadian Home Builders Association, Bridgewater, Nova Scotia.

Christian Ouettet: Architect, President of Solar Energy Society of Canada, Lac Brome, Quebec.

Rick Quirouette: B. Arch., Building Envelope Consultant with Morrison-Hershfield, Ottawa.

Dr. Virginia Salares: Chemist, specialist in housing for the environmentally hypersensitive, contract staff with Research Division, CMHC, Ottawa.

For more information on the House Designs of the Winners, Honourable Mentions and Finalists, directly or contact:
The Canadian Housing Information Centre (CHIC)
700 Montreal Rd,
Ottawa, On K1P 0P7
Tel: (613) 748-2367
Fax: (613) 748-4069

CHBA Pulse Survey

The CHBA Pulse survey gives a snapshot of the industry. We've pulled out some of the more interesting results from the latest survey.

* Improved energy efficiency has a significant penetration. Over 80% of builders across Canada use 2x6 framing on their houses; only 16% use 2x4. B.C. and Ontario are the only provinces with a significant number of builders still using 2x4 framing.

* Almost 30% of builders surveyed are R-2000 builders - a further 18% indicated they intend to become R-2000 builders within the next two years. Why? To keep up with current technology (almost 2/3 of builders indicate that this is very important to them).

* Lack of consumer awareness a major problem for R-2000 - when asked the main problems they faced in building R-2000 homes, over ½ of the R-2000 builders indicated that "lack of consumer awareness of R-2000" was a problem. Over 3/4 of the R-2000 builders indicated that consumers were unwilling to pay the premium for R-2000. The views of a large proportion on non-R-2000 builders was that they did not intend to become R-2000 builders because of the lack of demand from buyers.

* What draws customers to R-2000 homes? Comfort, quality and energy cost savings. Certification of the home as R-2000 is much less important to customers.

* Move-down buyers comprise only a small share of the market - they are most significant in B.C. where 13% of builders indicate they will be their main target market in 1992.

* The main change planned by builders is smaller houses - 2/3 of builders planning changes will build smaller houses in 1992.

Technical Research Committee News

Canadian Home Builders' Association

Drywall Staining

In the past few years, drywall staining has caused builders lots of problems. Fortunately, the problem seems to have decreased over the past six to ten months. Staining happened at drywall joints in a two to three inch wide band on either side of a drywall joint. The intensity appeared to be a function of the jointing compound thickness. In all cases, a flat latex paint had been used.

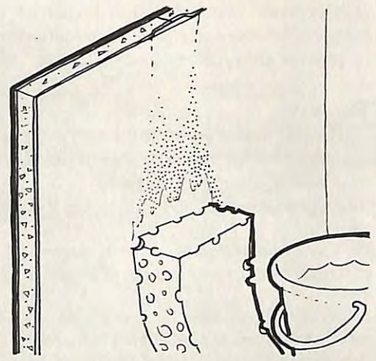
After a long study, it has been found that the drywall staining was caused by the reaction of mercury, (generated by the breakdown of fungicides in the jointing compound), with atmospheric hydrogen sulphide to produce a black insoluble salt. The fungicide phenol mercuric acetate (PMA) in the jointing compound; UV radiation in the form of lighting; Hydrogen sulphide (H_2S) present in the air; humidity levels in the house; permeability of the paint; and moisture trapped in the wall during painting all reeacted together.

Moisture was a major factor in the reaction as areas with high humidity and limited ventilation during construction and occupancy are often affected; lightweight muds and latex paints used may have contributed to the problem.

Ways to remove the stain and prevent the recurrence of the stain include bleach washing and re-coating with low permeability paints. An essential aspect in the prevention of staining is the provision of sufficient time for the initial paint coat to dry before applying a final coat.

What are the remedial actions to take?

Washing with bleach dissolves the mercuric sulphide and fades the stain, but with time and given the right conditions



the stain will reappear. Low permeability paints can seal the PMA into the system, but proper drying time between the first and subsequent paint coats is essential.

Stains should be washed with a 5 - 10% bleach solution (strength depending on the intensity of the stain). Where severe staining has occurred more than one bleach wash may be necessary. The washed surface should be allowed to dry 24 hours before any other treatment is undertaken. Washing will slowly dissolve the stains so scrubbing is not needed. It should be followed by a thorough rinsing with water and sponge to remove the bleach. The stain may reappear if the surface is not sealed after the bleaching operation so the surface must be sealed using an appropriate paint.

Paint the wall with a latex sealer. Allow the sealer to dry 24 hours and then apply a second coat of paint. The type of paint used in this second coat will depend on whether or not the wall is located in an area of high humidity. Coating a stained wall with an impermeable paint encases the mercuric sulphide and the remaining PMA preventing further reaction with H_2S present in the air.

In rooms where high humidity levels are present (e.g. bathroom, kitchen) an alkyd paint should be used as a finish coat. All other conditions permit the use of either a latex or alkyd based finish coat. If the humidity level in the affected room is in doubt, then an alkyd paint should be used as a finish coat.

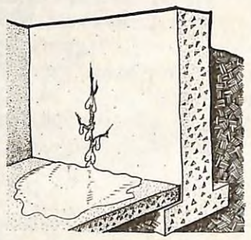
Basement Leaks

Basements leak too often. Home buyers, builders and warranty programs suffer when minimum standards are too low. A survey for the Ontario New Home Warranty Program showed that 21% of new home buyers across Ontario report unacceptable leakage the first year or two.

A Toronto builder said that about 1/3 of new homes experience call-backs in the first year to repair basement leaks Because of this track record, basement construction detailing has been studied extensively. MOstly, it's a problem of inadequate attention to proper construction details.

Basement water protection measures have not changed substantially in 50 years. Now we know how and have the technical solutions for building dry insulated basements. The key is dealing with water around the house; there are several ways to do it effectively.

Recent basement construction studies were spurred on because of an Ontario proposal to require full depth basement wall insulation. The results of the studies have led to proposed changes by the Ontario New Home Warranty Program to basement construction requirements of the National Building Code. The proposed code changes reflect minimum good building practice that if followed carefully, should mean dry basements most of the time.



What are the proposed changes?

Damp-proofing or waterproofing must be provided to prevent water finding its way into the wall. Coverage should be from grade level to the top of the footing.

The damp-proofing or waterproofing should be a permanent, inert membrane having a low permeance, able of bridging any openings, joints or cracks in the wall (at least 3 mm wide) fully adhered and/or secured and sealed at the so that water can't enter and be trapped between it and the wall.

A plain membrane is an acceptable minimum where backfill damage is prevented, workmanship is good and (especially where the wall is insulated on the interior) there is very little construction moisture and condensation is minimized. Above-grade entry of water must be prevented so that it is not trapped behind the membrane.

Alternately, an inert material that incorporates a free draining air space between it and the wall can be used. This would apply to Baseclad (rigid fibreglass board) or any of the specially made draining mats that are available.

Bituminous or other damp-proofing materials may be permitted if the soil or backfill drains freely and is applied from the footing to within 8" of the finished grade and is capped by impermeable soil, sloped away from the house or the drain material or insulating-drain material is placed between the soil and the damp-proofing, or an impermeable insulation or similar material is placed between the soil and the damp-proofing.

The proposed code changes leave the door open to innovative solutions that are other than the "deemed-to comply" examples.

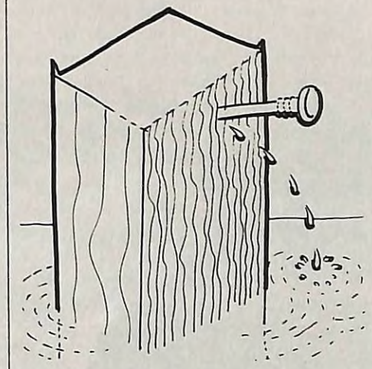
The "air space" membrane is an example of the minimum necessary especially where considerable construction moisture must be dissipated.

When Unit Masonry foundation walls are used they must be parged on the exterior face below grade level, while concrete walls that are to be damp-proofed must have any honey combing and voids left after removal of form ties sealed with mortar or damp-proofing.

In silty soil areas with higher rainfalls (over 600 mm or 23.6 inches) the drain tile or pipe must be provided with an accessible clean-out or be protected from silt infiltration.

Providing free draining materials on the soil side of even today's minimum damp-proofing will achieve dry basements if above-grade entry of water is prevented.

The Technical Research Committee (TRC) is the industry's forum for the exchange of information on research and development in the housing sector. Membership includes builder members and representatives from industry, standards and governments bodies with an interest in housing. Anyone with a problem, technical question of suggestions for areas that need to be investigated is encouraged to contact their local Home Builder's Association technical committee or the TRC directly.
To contact the TRC:
Canadian Home Builders Association,
200 Elgin St. Suite 502, Ottawa, Ont. K2P 1L5
Tel: (613) 230-3060



Moisture in lumber

Moisture in construction is a problem, especially where drying is poor for a large part of the year and when a lot of moisture is locked into walls at time of construction. Today's walls do not "breathe" as easily as in the past.

Attention to vapour barriers, the use of more insulation and panel materials has led to the construction of tighter houses. Houses are more energy efficient and they perform differently. This can lead to higher relative humidity conditions and potentially higher levels of indoor pollutants. The R-2000 program has dealt with these concerns by proper attention to ventilation.

Initial moisture conditions in wood framing are more important than before as wet construction materials can be a primary cause of moisture loading. Severe problems have been found in various places, so that Forintek was did a study for CMHC to measure the moisture content of lumber used in residential construction across the country.

The study looked at 10 cities across the country over a one year period to ensure that all construction seasons were included. Measurements were made before the insulation, vapour retarder and drywall were installed. Two studs and one plate in each of four exterior walls at each house were measured. In all 4093 studs (most were 2x6) and 2046 wall plates were measured in 515 houses across the country.

Generally the driest studs were found in the summer and the wettest during the fall

and winter. Lower moisture contents were found in houses where the builders used heating (during winter construction) before closing walls in. Wall orientation didn't make any difference on moisture content of lumber.

On the Prairies surfaced-dry (S-DRY) lumber is commonly used. Based on current industry practices most S-DRY is kiln dried. In the Atlantic and Quebec regions most houses are built using green lumber (S-GRN).

Potential climatic drying influences were examined but there was no consistent pattern throughout the country. This was done by comparing the moisture content of the framing and the elapsed time from the start of framing. S-GRN lumber in the Atlantic region showed significant drying with time, but the overall moisture content levels measured remained high.

Rules require that kiln dried (S-DRY) lumber have less than 19% MC, but up to 5% of the pieces in any batch can be over the limit. Most of the time this was not met in all areas.

In the Atlantic Region 46% of the samples were over the 19% moisture level, in Quebec it was 69%, in Ontario 30%, in the Prairies 9%, and in the Pacific region 55%. While the high moisture levels may be due to re-wetting, the extent of excess moisture suggests it's due to inadequate initial drying. The regional nature of the problem is also aggravated by the varying percentage of difficult-to-dry balsam fir and alpine fir in the lumber mix.

Wall plates tended to have higher moisture levels than wall studs; at least 82% of S-GRN wall plates were over 19% moisture content (MC) and at least 35% were over 30% MC. These numbers were larger in the Atlantic area where higher moisture contents were found. Plates get wet more frequently by rain during construction and don't dry as quickly.

At least 77% of the builders visited noted they had problems with drywall cracking or nail popping. This can be explained by the high proportion (45%) of builders using S-GRN lumber and the amount of S-DRY lumber over the 19% MC. Nail popping and drywall cracking happens due to lumber shrinkage, which only begins when lumber starts drying below fibre saturation (about 30% MC). Final moisture content of wood in a wall can be as low as 6 to 8% so a lot of shrinkage takes place after the installation of drywall.

There's enough kiln drying capacity in the country to meet the demands of domestic markets, even if all builders were to use S-DRY lumber. Most of the drying capacity presently is used to fill export market orders.

What did the study recommend?

That builders secure information on the best practices to deal with construction moisture, and that they become more conscious of moisture in framing lumber.

That the lumber industry implement better quality control in kiln drying, and that importance of dry lumber to the building industry be emphasized to the producers; smaller lumber producers who can't afford to set up kiln drying facilities should consider cooperative drying facilities.

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